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SCIENCE

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THE RESOURCES OF MONTANA AND THEIR DEVELOPMENT.*

IN casting about for a theme for discussion at the opening of this the second meeting of the Montana Academy of Sciences, Arts and Letters, it seemed appropriate to follow some of the ideas suggested in my preceding address, and elaborate more fully the ideas advanced. This is all the more necessary since the work of the academy is yet in a formative period, and the members to a large extent have no means of communication save by mail. They have to a large extent not grasped the idea of the necessity of individual effort to do something definite in original work. This is not surprising from the fact that one easily loses enthusiasm and interest in the absence of kindred spirits with whom to talk matters over and thus keep alight the spark of interest.

The state of Montana, the state of grand mountains, whose snow-clad summits pierce the clouds, and whose hidden treasures are of untold richness; the state of blue sky, clear sunshine, pure air and crystal water; the state rich in mineral wealth, rich in timber resources, and with great possibilities for agriculture; the state with beautiful lakes, foaming rivers whose waters teem with the finny tribe, and with broad and fertile valleys rapidly filling with happy and prosperous people; the state in which are raised the finest and fleetest horses of the world; the state with its five millions

* Address delivered at the second annual meeting of the Montana Academy of Sciences, Arts and Letters, at Anaconda, Mont., December 29-31, 1903.

of sheep, its three quarters of a million of cattle, its one fifth of a million of horses; the state whose annual production of gold is five millions of dollars, of silver twenty millions, lead sixteen millions of pounds, copper a quarter of a billion of pounds, two million tons of coal, a half million dollars in stone, a half million dollars in brick and clay products; the state with its two millions of fruit trees, already producing a quarter of a million boxes of apples, its one and a quarter million tons of hay and nearly ten million bushels of grain; the state with its three thousand miles of railroads, its 42,000 square miles of forests, with a saw-mill product of nearly two millions of dollars annually; and yet the state is in its infancy. Its resources are barely known, and many are practically untouched.

The state has within its borders approximately ninety-four million acres of land. Of this amount twenty-six millions of acres are classed as mountain lands, thirty millions as farming lands, and thirty-eight millions as grazing lands. This is approximately 40,000 square miles of mountains, 50,000 square miles of farming lands and 56,000 square miles of grazing country. To put it in another way, the mountain area of the state is about equal to the entire area of either Indiana, Kentucky, Virginia, Ohio or Tennessee. Its grazing land is more than the total area of either Pennsylvania, Louisiana, Mississippi, New York or North Carolina. Its farming land is as much as in the entire state of Wisconsin, Iowa, Illinois, Michigan or Georgia.

We have a state with a mountain area of that of all Tennessee, a grazing area equal to all the area of Pennsylvania or New York, and farms left to cover the states of Illinois or Iowa. The mineral wealth of this state of mountains is as yet unknown, and new prospects open daily. The grazing possibilities are being greatly

increased in the grazing section, and even much of the mountainous country has abundant and rich feed in summer. The agricultural region has yet to develop, but sufficient has already been done to predict a great future for the industry.

With a state equal in size to Indiana to supply gold, silver, copper and lead, as well as building stone and coal, another state equal in size to Pennsylvania to supply the beef, mutton, horses and goats for the mining population, and a state equal to that of Illinois to supply the grain, vegetables, fruits and hay, Montana is an empire in herself, capable of supplying all her wants. Clothing from wool, wealth from mines, grain and fruit from the fields and orchards, houses from the clay, rock or lumber, paper from the forests, coal from the hills, implements from the metals, gems from the mines, art in the peaceful valleys and rock-ribbed hills, fiction in Indian lore and trapper's tale of privation and suffering, poetry in nature, health in the air so pure and dry, sport in the hills or along the streams, all these make it possible for the citizens of this great empire to find at home, in their own state, all the essentials for modern civilized life, from the wants of nature to the esthetic realm.

Montana is a synonym for opportunity. This great state has less than two inhabitants per square mile. It presents to the man of health, energy and industry, an opportunity for successful business enterprise or professional advancement. Everywhere, on every side, there is opportunity. The great upheavals during the past geological ages have made mountain chains of great length and height, in whose depths man has already found untold wealth, and the hidden mineral yet unknown must be the heritage of the children of the future.

On the agricultural side what are the prospects for the future, based on the results of the experiments up to the present

time? The western part of the state is fast developing into a fruit region that will soon head off the great import of these products from Washington, Oregon and California. Of course the semi-tropical fruits will never be grown, but apples, pears, plums, small fruits and the like find here a climate suitable for growth. Nor is the region confined to the growth of fruits. Through irrigation great stretches of land grow waving grain, never failing the diligent farmer who but watches his fields.

On the eastern side the agricultural development has been beyond the most sanguine expectations. The valley of the Yellowstone has not only proved to be well adapted to fruit raising, but is now a great agricultural region. The climatic conditions are not as severe as were at first thought, and the outlook is as bright there as on the western side. The fame of the Gallatin valley is already widespread.

In the north is a large and unoccupied territory. Great stretches of tillable land await but the addition of water, which will make the country as rich and as prosperous as other sections of the state and country. The work of reclaiming the land is too great an undertaking for individual or corporate enterprise. But the beneficent effects of congressional legislation for the reclamation of arid lands through irrigation will soon be seen. In that northern section alone millions of inhabitants can find homes and occupations when the land is tilled. Abundant harvests will be gathered from the land, and cities will be found where now are trading posts and virgin soil.

During the past year it has been my pleasure to visit several parts of the state in connection with the work of the farmers' institutes. The gentlemen who have made up the companies of these institute instructors have given the closest attention to the

possibilities of the regions of the state visited. Mr. W. B. Harlan, the veteran fruit grower of the Bitter Root valley, expresses the opinion that apples and small fruits can be grown successfully in the northern section of the state, although in the spring of 1903 there was not an orchard east of Chinook, and but one there. Professor F. B. Linfield, of the Agricultural College, believes that dry land farming, without irrigation, will in a few years be an important factor in the state's agricultural development. Professor Fisher, horticulturist in the Agricultural College at Bozeman, like Mr. Harlan, is also of the opinion that fruits may be grown where now it seems impossible to grow them.

What of the mines? The future for agriculture is no brighter than that for mining. 'New districts of magnitude and splendid values are constantly being developed,' says the State Commissioner of Agriculture. While the early history of the state is really the history of the development of some of its mines, mining now is not confined to a few sections of the state. In 1900 mining was carried on for gold and silver in the following counties: Beaverhead, Broadwater, Cascade, Chouteau, Custer, Deer Lodge, Fergus, Flathead, Granite, Jefferson, Lewis and Clarke, Madison, Meagher, Missoula, Park, Ravalli and Silver-Bow. Lewis and Clarke was the greatest producer, with 70,000 fine ounces of gold and 172,531 fine ounces of silver. Custer County was the smallest producer, with 14.5 ounces of gold and 4 ounces of silver. The total product of gold and silver in the state in 1900 was 229,114.882 ounces of the former and 14,294,835.11 of the latter. In 1901 there were 232,331.454 ounces of gold and 14,180,545.19 ounces of silver. Since the discovery of gold in the state forty years ago more than one billion dollars in value of gold, silver, copper and lead have been

taken from the streams and mountains of the state. The industry is one of great importance to the state.

In 1901 copper was mined in the counties of Beaverhead, Granite, Jefferson, Lewis and Clarke, Madison, Meagher and Silver Bow, the last producing 227,742,262 pounds of the 228,031,503 pounds total. Lead was produced in all the counties mentioned except Madison, and in addition also in Broadwater, Cascade and Flathead. Broadwater and Meagher were about equal producers, with about two and one half million pounds each.

Coal statistics from an article by Professor J. Perry Rowe, of the University of Montana, which appeared recently in the *American Geologist*, show that Montana is undoubtedly one of the richest states in coal and lignite, although as yet these deposits have been but very little developed.

"All or most of the bituminous and semi-bituminous coals found in Montana come from the Cretaceous period and usually from the upper part, or the Laramie formation, and are found east of the main divide of the Rocky Mountains. The lignite is found both in the Cretaceous and later Neocene formations."

Professor Rowe says that it has been estimated that there are 13,000 or more square miles of Cretaceous bituminous and semi-bituminous coal area in Montana, and about 25,000 square miles of lignite area. "Not that all of this area is underlain by coal, but that the deposits are found quite abundantly throughout the territory." According to this estimate the coal area of the state is about one fourth of the entire area of the state. He says: "The bituminous area of Montana is greater than the combined bituminous areas of North Dakota, South Dakota, Wyoming, Washington, Oregon, Idaho and New Mexico. The lignite area is next to that of North Dakota,

which has a larger lignite area than any of the northwest states." The tests show the Montana bituminous coal to be but little inferior to Pennsylvania bituminous coal. Professor Rowe reports that bituminous coal or lignite has been found in every county of the state except Jefferson County. The undeveloped coal industry will without doubt be a prominent factor in the expansion of other industries of the state.

Sapphire Fields.—Montana sapphires were first described in 1873 by J. Lawrence Smith, but actual mining began in 1891. One sapphire belt is twelve to eighteen miles east and northeast of Helena, and has been followed for about twelve miles, from Canyon Ferry down the river to American Bar. Sapphires have also been found at Rock Creek, Cottonwood Creek and Yogo Gulch. The Rock Creek region is about thirty miles west of Anaconda, the Cottonwood Creek field about ten miles east of Deer Lodge, and the Yogo mines in Fergus County, about thirteen miles west of Utica. The only systematic mining for sapphires in the United States is done in Montana. The annual output of sapphires in the state is something like 450,000 to 500,000 karats, including those suitable for cutting and those used for mechanical purposes. A lapidary at Helena has fifteen workmen cutting stones, and it is asserted that finer work is done here than on stones sent to be cut in London. "Altogether," says State Commissioner Ferguson, "the output of precious stones in Montana exceeds the production of all the rest of the United States, and forms a very interesting addition to our industries."

The Lumber Industry.—For the year ending June 30, 1902, 69 mills were running, with a total output of 210,047,000 feet of rough lumber. There were, in addition, from these mills, about five and a half million shingles and seventeen million

lath. The United States Geological Survey estimates the timber on the Lewis and Clarke forest reserve at 2,664,360,000 feet, board measure, and on all the reserves in the state 14,974,800,000 feet of merchantable lumber. It is estimated that there are 912,000,000 feet on state lands, bringing the total estimate of merchantable timber belonging to the state or government up to 15,886,800,000 feet. This does not include timber on the Northern Pacific Railroad land nor on the land belonging to the various mills. At the present rate of consumption the timber on the state and government lands would satisfy the mills for about seventy years. But the rate of consumption is increasing very rapidly.

An analysis of the industries which are lacking or very small shows the following: There are no zinc smelters in the state. The industry in iron and steel is not yet an integral part of the wealth of the state. Notwithstanding the timber and grain in the state there is not one pound of paper manufactured in the state. There are very few factories. The dairies are few and do not begin to supply the demand for butter. Montana produces 61 per cent. of the copper of the United States, but not a pound is converted into the finished product. Although Montana has more sheep than any other state in the union, it has but one woolen mill in the state.

If one wishes to make a study of the geology of the state or its natural history he has little to work on. Let the average student attempt to find out what is known relative to any section of the state, and he will have much difficulty. A portion of it has been covered by the work of the United States Geological Survey; much of it has not been studied. There is nothing obtainable save extracts from reports relative to the geology and natural history of the state. Teachers, students, private individuals alike must seek the libraries and cull

from its numerous reports a small amount of information. Let me illustrate.

A student wishes to begin the study of the butterflies of the state and desires literature to aid him. What must he do? The eastern books cover the ground to the Great Plains. The insects from the Rocky Mountains are in great confusion. There is nothing to be placed in the hands of the student who wishes to work. He may secure Edwards's books with colored plates and full descriptions at \$135. He may secure Holland's book with colored plates at \$3. But without keys and full descriptions he can do little. Moreover, the material gathered from the state is very small, and collections are few. The student is beset at once with difficulties when he undertakes the work. His difficulties increase with continuance of study, and there is no help for him. The same is true of the study of fishes, birds, plants or mammals. There is nothing that the student who has not reached the plane where he can be called specialist may have for aid, unless he goes to the expense of books treating of the entire country. Even these will fail him often.

The study of the state's resources must be pursued with a twofold object in view: (1) To encourage immigration, (2) to enlighten the citizens of the state. We must all agree with Mr. Ferguson in his opening statement in his report as commissioner of agriculture, labor and industry for 1902, in which he says: "The magnitude and diversity of the natural history resources of this great state, the opportunities for the acquisition of comfortable homes and profitable investment are known to comparatively few people outside of its borders. It is clearly within the bounds of propriety for the people of any community to determine accurate knowledge of its advantages and invite immigration." We may as truthfully say that

it is clearly within the bounds of propriety for the people to determine for themselves what their natural advantages are, for their own enlightenment, for the education of the younger generation and for the development of the industries yet in infancy on a basis made from scientific study. I should make it more emphatic. It is not only within the bounds of propriety for the citizens of the state to do this, but it is their duty to promote the knowledge of their own material resources. We need people; there is no doubt of that. The state can easily support a population of several millions when its soil is under cultivation, when its orchards are bearing, when its new mines are opened up for full work and its other industries have developed. We need people, and we need them badly. We need capital also. This will come as soon as it is demonstrated that investment will be safe. But we are here, a quarter of a million of us. We are here, for the most part, to stay. The state's geological wealth and natural history wealth are the property of the people, and the people know little about it. It is not good business to be possessed of valuable property without making strenuous efforts to know something about the property.

Professor J. M. Hamilton said recently, in speaking to the students of the University of Montana, that the chief aim in our system of education should be to develop our resources and to know them, and that this will require the highest type of brain work. The resources are so varied that wide latitude may be had in the selection of work. The conditions are so varying that the greatest intelligence is necessary to carry on work which in other states requires little thought. The farmer must be an intelligent man and a student in order to handle water properly, so as to get the best results. The miner must be more than a laborer. He must know chemistry

and physics. Every man must know more than is demanded of him by his daily work. He must have a big reserve.

The best men for developing the industries of the state will come from the youth of the state itself, if they are given the same facilities for carrying on their studies as are given their eastern competitors. These facilities are fast being supplied by the state institutions for higher education, which are now giving strong competition to the older and more widely known institutions. Add to this equipment the knowledge that may be had through daily contact with home conditions through the formative period of youth, and the young man will have the best equipment for his work that can be had.

The drift of my thought you have no doubt long since gathered. I am arguing for a geological and natural history survey by the state, for and by the people of the state and for outsiders if they wish to come into the state. We should have it. I believe we can have it, but we must work for it.

The history of the surveys of older states, and the reports printed, are ample proof of their utility. The value of a survey is beyond question. Granting that it should be established, the next step is to determine the breadth of the movement, the scope of the work, the policy to be pursued and the expense involved.

The survey should begin modestly, not attempting too much, developing plans slowly. Its board of directors should be entirely free from politics, and should include representatives from the various state institutions, and should include the governor of the state as chairman or president of the board. The bill recently drafted for the Wisconsin survey is a good model for use. All the institutions interested and all the scientific bodies should be made to feel that they are to have a

part in the work, for to get the best results will require the best effort of the best heads in the state. A governing board consisting of the governor, the president of the university, the president of the school of mines, the president of the agricultural college or the director of the experiment station, the president of the academy of sciences, arts and letters, with perhaps the president of the state board of horticulture and the president of the society of engineers, would certainly be above criticism, and would adopt a broad and liberal policy that would bring about excellent results.

The plan of operation should, of course, be left to the governing board, but the bill should specify the scope of the survey, which should include both the geology and the natural history of the state. This is the belief of those who have had much to do with the older surveys.

The expense should be modest for a beginning, and the work should be developed as necessities may warrant, or men of ability in special lines may be secured. A tax of one tenth mill for fish and game produces a revenue of from \$17,000 to \$18,000. A tax of equal amount for a state survey will give it a good start and make it possible to do most valuable work. An appropriation of not less than \$10,000, and possibly \$15,000, will enable the work to start at once with sufficient breadth to develop in several directions.

The work of the survey will take many years. Most of the work in the field will be in the summer. I doubt not men from the state institutions can be secured without big outlay for salary. This is at least to be expected. It will no doubt take years to carry out some of the outlines that will develop. Men living in the state who are in the employ of the state and who are fitted should be most valuable in many ways. Others not in state institutions will

be found who will no doubt gladly assist, and there are many such who are competent. There is a long list of competent men to be found in the state, competent for some one line of work, at least. A few of these are already on the roll of the academy; more of them should be.

The above plan is, I believe, feasible. In one year the legislature meets. The state is in good financial condition. There is no reason why the survey should not be started. Some one must start it. The academy should foster the move. I advocated the move last year at our first meeting. I repeat it and urge action on the part of the academy. Speak of it through the press. Present it to those who have influence. If we all work zealously and earnestly it will surely go.

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SCIENTIFIC BOOKS.

The Harriman Alaska Expedition. Vol. III., *Glaciers and Glaciation.* By GROVE KARL GILBERT, pp. i-xii, 1-231; 18 plates and 106 figures. Vol. IV., *Geology and Paleontology.* By B. K. EMERSON, CHARLES PALACHE, WILLIAM H. DALL, E. O. ULRICH and F. H. KNOWLTON, pp. i-x, 1-173; 33 plates and 18 figures. Published by Doubleday, Page and Company, New York, 1904. Size 7 by 10 inches.

Volumes one and two of the Harriman Alaska Expedition, containing a narrative of the journey and treating of the glaciers, natives, history, geography and resources of Alaska, were published in 1901. The two volumes recently issued are of special interest to geologists, and still others, as is understood, devoted to botany and zoology, are yet to come.

The Harriman Expedition, it will be remembered, was primarily a journey for pleasure and recreation, which twenty-three literary and scientific men were invited to accompany and it became a scientific reconnaissance embracing a wide range of subjects. The expedition